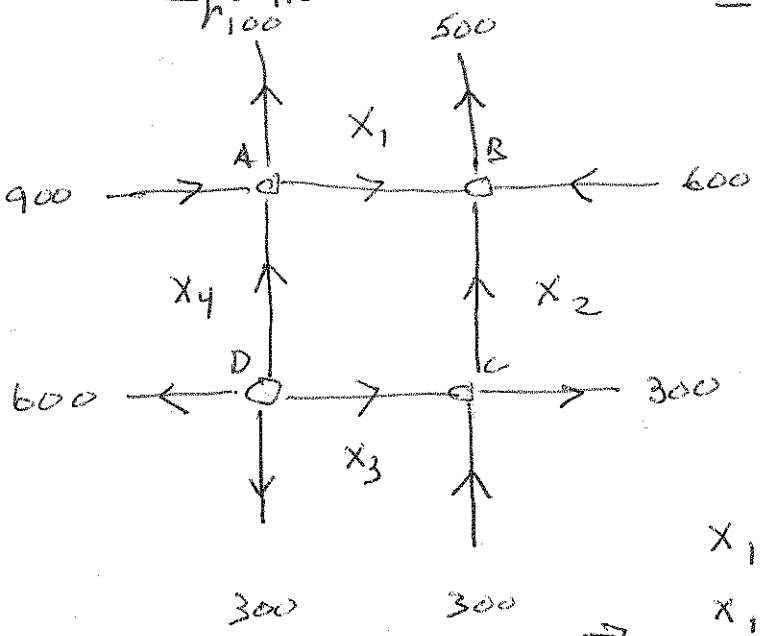
1, 4
1/2

Applications of Linear Sys.

(1) Traffic Flow along oneway streets,

Assumption; The flow into a Node (intersection) equals the flow out.



A: $900 + X_4 = 100 + X_1$

B: $X_1 + X_2 + 600 = 500$

C: $X_3 = 300 + 300 + X_2$

D: $0 = 600 + 300 + X_4 + X_3$

$\Rightarrow$

$$X_1 - X_4 = 800$$
$$X_1 + X_2 = -100$$
$$X_2 - X_3 = 0$$
$$X_3 + X_4 = -900$$

$$X_1 = 800 + X_4$$
$$X_2 = -900 - X_4$$
$$X_3 = -900 - X_4$$

$\Rightarrow$

$$\begin{bmatrix} 1 & 0 & 0 & -1 & 800 \\ 1 & 1 & 0 & 0 & -100 \\ 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 1 & 1 & -900 \end{bmatrix}$$

a) in general, 400 cars/hr use X_1...

b) after an accident, X_3 is closed down... $\Rightarrow$

inconsistent.

$$\begin{bmatrix} 1 & 0 & 0 & -1 & 800 \\ 0 & 1 & 0 & 1 & -900 \\ 0 & 0 & 1 & 1 & -900 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

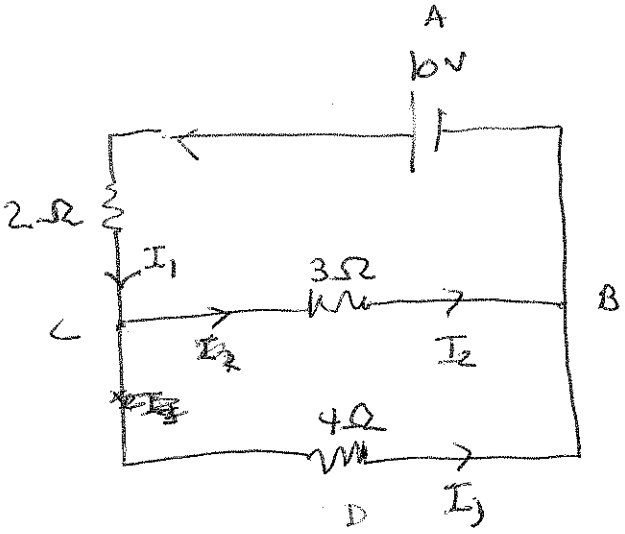
(2) Electrical networks (current flow thru simple networks).

Need to know

(a) Ohm's Law: the voltage drop across a resister is the product of the current & resistance.

(b) Kirchhoff's 1st Law: current in = current out of a node.

(c) Kirchhoff's 2nd Law: the sum of the voltage drops around a loop equals the total voltage of the loop.



1st Law $0 = I_1 - I_2 - I_3$

(A C B A) $10 = 2I_1 + 3I_2$

(A C D B A) $10 = 2I_1 + 4I_3$

(C D B C) $0 = 3I_2 - 4I_3$

$$\Rightarrow \begin{bmatrix} 2 & 3 & 0 & 10 \\ 2 & 0 & 4 & 10 \\ 1 & -1 & -1 & 0 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 1 & 0 & 2 & 5 \\ 0 & 1 & -4/3 & 0 \end{bmatrix}$$

$I_1 = 5 - 2I_3$

$I_2 = \frac{4}{3} I_3$

$I_1 = 35/13$

$\Rightarrow I_2 = 20/13$

$I_3 = 15/13$